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THE WHOLE BUILDING DESIGN GUIDE – A RESOURCE FOR QUALITY, ENERGY EFFICIENT BUILDINGS

Richard R. Paradis, P.E.
NAVFAC Criteria Office
(757) 322-4447

INTRODUCTION

The Comprehensive National Energy Policy Act (EPACT) of 1992 and the Energy Executive Order dated 8 March 1994 provide the basic direction for the Defense Department and the other Federal agencies to proceed toward achieving facilities that are more energy efficient than in the past. The Defense Standardization Program, initiated in 1994, has directed DOD to use commercial, state-of-the-art technology and performance-based, commercial specifications and industry standards. More recently, we have been challenged by the DOD Facility Global Climate Change Implementation Plan, the Million Solar Roofs Initiative, and the Partnership for Advancing Technology in Housing (PATH). How can we possibly deal with all these orders and initiatives? The solution offered in this paper is the Whole Building Design Guide, developed for the U.S. Navy by the Passive Solar Industries Council (PSIC).

BACKGROUND

EPACT and the Energy Executive Order contain words like: "…reducing energy consumption by 30 percent by the year 2005" and "the Federal Government is to significantly increase the use of solar and other renewable energy sources." They also tell us to "… design and construct (new) facility(ies) to minimize the life cycle cost of the facility by utilizing energy efficiency, water conservation, or solar or other renewable energy technologies." In addition, we are told that "Agencies shall purchase energy-efficient products in accordance with the guidelines issued by OMB." The NAVFAC Energy Criteria Team (NECT), a multi-discipline, technically-knowledgeable cross-section of the NAVFAC organization, recognized the need to change the way we were doing business, to have any chance for success in accomplishing these goals. The NECT and the NAVFAC Criteria Office jointly undertook the challenge of developing a tool that would address the integrated design process and how to apply it to Navy projects. At the same time, NAVFAC Headquarters embarked on the journey to sustainable design

by initiating showcase projects and design charettes to identify energy saving possibilities that were not previously considered feasible. Adding to the challenges of the EPACT and Executive Order are those set forth by the Defense Standardization Program, the DOD Facility Global Climate Change Implementation Plan and the other initiatives mentioned above, making the message clear:

- **Do a better job of designing, constructing, operating, and maintaining Defense Department facilities!**
- **Do it using commercial-based standards.**
- **Make the facility sustainable and super energy-efficient.**
- **Incorporate renewable energy alternatives into the project.**
- **Do all this and be sure the results are life cycle cost effective!**

ACCEPTING THE CHALLENGE

Wow! Should we all just go home now muttering to ourselves that it can't be done? That no one has ever done such a thing? And, that no resources exist to guide us in accomplishing this monumental task?

The answer to the first question, of course, is **No, let's not go home because we will prove that it can be done!** As professionals, we shall accept this challenge, just as we have accepted the many other challenges we have faced in applying new technology to our facilities projects.

The answer to the second question is **Yes! It has been done by others, both in the private sector and in the Federal Government!** Later in this paper, we will cite a successful "Green Building" project and mention organizations that are employing sustainability principles in the Federal Government, the private sector and Canada.

And the answer to the third question is **A powerful resource does now exist to do all the things stated in the bullets above!** If we were on the front lines fighting for our country's freedom, we could not achieve victory without a sound plan of action and powerful weapons at our disposal. To win the battle to produce quality buildings, while reducing pollution, conserving energy, increasing occupant comfort and productivity, and controlling cost, we also need a sound plan of action and a powerful weapon. The plan is the integrated design process and the weapon is the Whole Building Design Guide (WBDG).

WHAT IS THE WHOLE BUILDING DESIGN GUIDE?

This resource takes the place of many existing and outdated handbooks, guidebooks, and specifications manuals. Many of these documents contain only general information, which can be obtained easily from commercial sources. The WBDG will be available on the Construction Criteria Base (CCB) and a worldwide web site. The WBDG introduces and defines the whole building design process (generally known as the "Integrated Design Process"). The WBDG identifies and defines the role of the architect, engineer and project manager in that process. This resource will help the Navy's design professionals deliver high quality architecture; buildings which are durable, cost effective, sustainable, and climate-responsive. The guidance in the WBDG is also appropriate for buildings designed for the Army, Air Force, and other Federal agencies, as well. To summarize, the WBDG:

- Replaces outdated redundant criteria documents.
- Moves the Navy and Marine Corps building process more in line with the private sector.
- Simplifies access to information using a single document and a newly developed Web Site.
- Guides A&Es and project managers through the whole building approach to design.
- Provides specific energy use targets and environmental guidance consistent with commercial practice.

WHAT DOES THE WHOLE BUILDING DESIGN GUIDE LOOK LIKE?

This resource is concise, easy-to-read, beautifully designed, and explicit in its guidance to users. It is arranged in a series of "Modules" that lead the designer or project manager through the whole building design process.

MODULE ONE: OVERVIEWS AND TARGETS

This module provides an overview to describe the quality of the buildings the Navy wishes to procure. It defines the whole building process and describes the issues of integrating materials and systems and the implications of various tradeoffs.

MODULE TWO: RESOURCE PAGES

This module defines key issues or tools identified in Module One. Resource Pages included in the initial phase:

- Daylighting and Electric Lighting Controls
- Natural Ventilation in Buildings
- Building Integrated Photovoltaics
- Passive Solar Heating Strategies
- Sun Control and Shading Devices
- Contribution of Windows and Doors to Green Buildings
- Complying with ASHRAE 90.1
- Initial and Life-Cycle Costing
- Active Solar Applications
- Moisture Dynamics
- Aesthetics
- HVAC Systems and Controls
- Commissioning
- Operations and Maintenance
- Environmentally Preferable Products

Each Resource Page includes a definition, description and bibliography that directs users to relevant, current industry standards. Additional references are given for appropriate codes, procedures, existing documents, software, and training opportunities.

MODULE THREE: NAVY REQUIREMENTS

This Module directs users to resources (documents, handbooks, guidebooks, criteria, CCB, etc.) which cite special conditions and/or space requirements unique to Naval facilities. This is the Module where unique Army or Air Force requirements could be inserted. Beyond this Module, the WBDG should be universally usable for all DOD and other Federal agencies' building projects.

MODULE FOUR: SAMPLE GUIDANCE

This Module provides examples, samples, case studies, and computer simulations/output that follow the guidance set forth in the previous Modules.

WHY USE THE WHOLE BUILDING DESIGN PROCESS?

No doubt, the time has come for us to take a different approach to designing quality buildings. It is also clear

that energy conservation is a critical, integral aspect of quality building design.

Is this only the sentiment of a few NAVFAC engineers and architects? Definitely not! The following section will cover some key points related to energy conservation and the integrated design process as fundamental to the way we all should be designing facilities. Several sources outside of government are cited to show that the private (commercial/ industrial) sector understands the need to do the same.

In the commercial/industrial sector, the bottom line is paramount, so if they espouse energy conservation and integrated building design, we in government should take heed and act. Innovative thinking tells us we must change our ways now! Further delay will only compound the problem, increase the costs and waste valuable natural resources. Listen now to what knowledgeable people in the private sector have written about the integrated design process.

WHAT DOES IT TAKE TO DESIGN ENERGY EFFICIENT FACILITIES?

Incremental changes take us only so far. To quote E Source:

- "…Installing compact fluorescent lobby lights, VAV air handling, or an energy management system, most do not appreciate that such incremental changes fall far short of the profound and fundamental changes possible with **integrated design."** (Ref. 1)
- "A well-integrated and interdisciplinary effort by a design team is often the key to producing buildings that achieve exceptional energy efficiency and aesthetic comfort." (Ref. 1)
- "Increasingly, the realization is that truly **integrated design** can yield projects that are both ecologically and economically green." (Ref. 1)
- "The design process, now dis-integrated, must be re-integrated. To start with, only a fully coordinated, multidisciplinary, cross-boundary design team seems capable of producing exemplary results - and then only if at least one of its members (preferably the team leader but possibly an outside 'energy ombudsperson') serves as its 'energy conscience' and ensures that cross-cutting issues critical to the whole-system performance are solidly addressed." (Ref. 1.)

Consulting-Specifying Engineer Magazine is quoted as saying:

- "Integrating diverse systems and balancing their strengths and weaknesses can result in overall increases in efficiency. To be most effective, such **integration** must begin simultaneously with project development. A designer's early decisions in site planning influence later choices of both the building's mechanical and electrical equipment and its overall consumption."
- "The design stage is the active integration stage during which detailed suggestions will be raised, considered, modified, accepted or rejected. This is also the most interactive stage… At its completion, a detailed, workable design is in hand. Critical interactions for the systems design engineer are with the architect, structural engineers and the owner group." "The integrated building is essentially the building that is designed with foresight." (Ref. 2.)

More recently, in an editorial, the same magazine stated:

- "The inherent level of **integration** relates to physical interactions between building systems that may seem unrelated." The "attitudinal level of **integration** requires engineers to look beyond their traditional disciplinary boundaries and offer integrated solutions to their clients' problems." (Ref. 3)
- "What they (clients) want is solutions that make their buildings more efficient, productive and responsive to their environments."(Ref. 3.)

Our conclusion, then, must be that energy efficiency is an inherent part of the integrated design process. Put another way, "…increasing the involvement of all disciplines from the start of the design/construction process creates buildings - and building teams - where the whole is more than the sum of the parts." (Ref. 4.)

WHAT IS WRONG WITH THE CURRENT PLANNING AND DESIGN PROCESS?

The sequential process of planning and designing buildings, currently in use, makes scant allowance for innovation. Successful, energy-efficient, integrally designed buildings cannot be achieved by the linear design process and the current A/E contracting methods in use.

The whole building design approach asks the members of the planning, design and construction team to look at the materials, systems and assemblies from many different

perspectives. The design is evaluated for life cycle cost, quality of life, future flexibility, efficiency, overall environmental impact, productivity and creativity. The fundamental challenge of whole building design is to understand that all building systems are interdependent. Through a systematic analysis of these interdependencies, a much more efficient and cost-effective building can be produced. The choice of a mechanical system, might for example, impact the quality of the air in the building, the ease of maintenance, operating costs, fuel choice, and whether the windows of a building are operable.

The consequences of a linear approach to project development (the traditional facility development process and the current decision-making criteria paradigm) are eloquently addressed in Ref. 5., as are the framework for a sustainable system and specific strategies for attaining the desired results.

WHAT HAS BEEN DONE TO INDICATE THAT WE ARE ON THE RIGHT TRACK WITH THE WHOLE BUILDING DESIGN PROCESS?

Here we address sustainability principles, its application in the private sector, in the Federal Government, “Green Buildings” and related success stories.

SUSTAINABLE DESIGN – PRIVATE SECTOR

The worldwide architectural firm of Hellmuth, Obata & Kassalbaum (HOK) has incorporated the principles of sustainable design into the core of their operations. In 1995, HOK produced a Sustainable Design Guide. HOK initiated a sustainable design group. According to Sandra Mendler, Chairperson of the HOK Sustainable Design Group: “A sustainable design advocate has been identified in each office to participate on the corporate-wide team, and to organize a local team in their home office. The local green teams in each office allow for the dissemination of information to many individuals in each office. Specialist committees are organized by topic (e.g. sitework and planning, energy, water conservation, building materials, indoor air quality, etc.) and are comprised of professionals from a cross-section of disciplines.”

SUSTAINABLE DESIGN – FEDERAL GOVERNMENT

Several Federal agencies have published sustainable design practices or policies. Among them are the following:

- U.S. Postal Service Green Guidelines
- U.S. Air Force Sustainable Facilities Guide
- U.S. Department of State Green Specifications
- U.S. National Parks Service, Guiding Principles of Sustainable Design

(Note: the U.S. Army Corps of Engineers ETL titled, "Sustainable Design for Army Facilities" was in the draft stage at the time of this writing.)

SUSTAINABLE DESIGN WITHIN THE NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

NAVFAC chose eight pilot projects in which to apply sustainable principles promoted by the Rocky Mountain Institute. The lessons learned from the development of these projects and the recognition that implementing resource-efficient, facilities-related practices is imperative led NAVFAC to issue a sustainable design Policy Statement. In the Policy Statement, NAVFAC's definition of "Sustainable Design" incorporates the following:

- Increased energy conservation
- Increased use of renewable energy sources
- Reduction or elimination of toxic and harmful substances in facilities
- Improvements to interior environments leading to increased productivity
- Efficiency in resource and materials utilization, including water resources
- Selection of materials and products with recycled content
- Recycling of building materials after renovation or demolition
- Reduction of waste products during construction and facility operation
- Facility maintenance practices that reduce or eliminate harmful effects on people and the natural environment

NAVFAC's commitment to sustainable design is reflected in its criteria, its guide specifications database, and other policy and guidance for planning, programming, design, construction and facilities management.

"The Greening of Building 33 at the Washington Navy Yard" presented NAVFAC with the opportunity to apply sustainable

green design to its own new headquarters building. The project goals were:

- Renovate and adaptively reuse an historic building
- Create a flexible comfortable professional working environment
- Maintain the project construction budget at $19 million +
- Design to take advantage of unique historic qualities of Existing Structures

The existing structure in this case was a Civil War Era munitions factory. The challenge was to convert this historic factory into a modern, efficient and sustainable office building. A design charrette was held in the Spring of 1995 to investigate the potential for integrating green design and sustainable design strategies into the design and building program for Building 33 and develop a plan of action. Areas identified for investigations included: building envelope, lighting, HVAC, components/environment. The charrette concluded that '"Green Design" works best when fully integrated with the project planning and design process. Integrated design achieves maximum energy savings and improved quality of life.'

The greening opportunities identified by the Navy and successfully incorporated into the final project were:

1. Building Envelope
    - Improved Window Performance
    - Skylights w/Diffusers
    - Improved Wall and Roof Insulation
    - Reflective Blinds
    - Ceiling Height Raised
2. Lighting
    - Reduce ambient light level to 30 footcandles
    - Use indirect lighting and coordinate with daylighting
    - Use energy-efficient light fixtures
    - Use occupancy and daylight sensors
    - Reduced lighting loads from daylight and high-efficiency fixtures
3. HVAC
    - Reduced building loads by incorporating lighting improvements, insulation improvements, and reduced fan, pump, etc. power requirements
    - Refined calculation methodologies
    - Purge building of "off-gases"
    - Reduce sizes of and use high efficiency equipment
    - Ductwork and piping design – reduce size

- Use performance monitoring for verification of long-term cost savings

4. Components/Environmental
   - Select materials with low VOC content
   - Use water saving fixtures
   - Construction and demolition material recovery – recovery of concrete, etc.
   - Low maintenance landscaping
   - Minimize waste by recycling construction and demolition materials
   - Use materials with recycled content
   - Purge building with outside air prior to occupancy

The Results? For only a $95,000 addition to the original cost estimate of $19.8 million, significant greening opportunities were realized. The potential operating cost savings are $135,000 per year. The payback is less than one year. The Navy will save over $1 million in the next ten years on just this one project. (Ref. 6)

GREEN BUILDINGS

The government and the private sector have been designing and constructing “Green Buildings” for some time now. What exactly is a Green Building? “To be Green … a building should be designed, constructed, commissioned, operated, and maintained in accordance with agreed-upon principles balancing the needs of humanity with those of nature. It should minimize the use of non-renewable resources, use renewable resources where practical, and pollute minimally.” “… A Green Building should be beneficial to its occupants by promoting good health and productivity through acceptable comfort, indoor air quality, and human factors (lighting, ergonomics, aesthetics, and acoustics). On top of this, a Green Building should be affordable (and) aesthetically fit well into its community and environment…” (Ref. 7.)

GREEN BUILDINGS – A CANADIAN EXPERIENCE

British Columbia universities, colleges and institutes are growing at a tremendous pace - these facilities will increase anywhere between 35 and 55 percent by 2010. Recognizing that this surge in building gave them an opportunity to “do the right thing,” the British Columbia universities, colleges and institutes and the BC Ministry of Skills, Labour and Training committed themselves to environmentally responsible building design and operation. On a series of seven projects, BC proved that by effectively using daylight, incorporating sophisticated control systems

and utilizing high performance low impact exterior building envelopes, Green Buildings can be designed and constructed on time and within budget. (Ref. 8)

CONCLUSION

It is imperative that we begin applying the integrated design process to our facilities projects. A viable resource to do so exists. Employing that resource, the Whole Building Design Guide, will achieve the following:

- More energy-efficient buildings.
- Better living/working environment.
- Construction that is durable.
- Buildings that are sustainable and incorporate renewable energy sources.
- Designs based on commercial criteria that is already well accepted in the private sector.

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AUTHOR’S ADDRESS: NAVAL FACILITIES ENGINEERING COMMAND
NAVFAC CRITERIA OFFICE, CODE 15
1510 GILBERT STREET
NORFOLK, VA 23511-2699
COM 757.322.4447, DSN 262.4447
paradis@efdlant.navfac.navy.mil